With the prevailing greens and blues of the transmitted light there remains little else than intense black, contrasted with a light background, to serve for warning or recognition marks.

There is a common littoral fish (*Uranoscopus scaber*), a member of the same family as *Trachinus*, found in the Mediterranean Sea. Its habits, as regards burying itself in the sand, appear to be closely similar to those of the *Trachini* and it has an erectile first dorsal fin of a jet-black colour. There is a formidable spine on the operculum, and this fish, like *Trachinus*, is said to be poisonous. It inhabits the same grounds as *Trachinus*, and a black or black-and-white first dorsal fin appears to be as characteristic of the genus *Uranoscopus* as it is of the genus *Trachinus*. It is difficult not to conclude that it obtains a considerable amount of protection by possessing a conspicuous black dorsal fin, and that its close resemblance to *Trachinus* may be of mutual service to both kinds of fish.

On the other hand, it seems a general rule that in sand-loving round fishes, whatever colour-markings may be necessary tend to become concentrated in the dorsal fin, which alone is visible when the fish is buried in sand (*cf.* Gobiidæ, Centronotidæ, &c.).

Notes on some Freshwater Sponges collected in Scotland.

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[Read 2nd April, 1908.]

As the local records of freshwater sponges in Scotland appear to be neither numerous nor altogether trustworthy, I have thought it worth while to publish the following notes, which are based on specimens submitted to me by Sir John Murray and Mr. W. Evans and on others found by myself during a recent visit to Scotland. I do not think it probable that the two species here recorded exhaust the list of those that occur, but few naturalists have taken the trouble to collect the Spongillinæ of Great Britain, which are therefore imperfectly known. Several interesting forms will probably be discovered in the lakes of Scotland and England if stones from the bottom are examined. So far as my own experience in Scotland and India goes, the under surface of stones from lakes is a favourite station for the less conspicuous and smaller species, which are in many respects the most interesting. These are not always easy to distinguish at sight from patches of algæ, but their gritty constitution, due to the spicules of which their

skeleton is formed, can usually be felt if they are held between the finger and thumb, and in most cases it is possible to distinguish the spicules with the aid of a hand-lens. Freshwater sponges should either be preserved in very strong spirit—absolute alcohol if possible—or dried. I shall be glad to examine and report upon specimens sent to me at Calcutta.

Spongilla lacustris auctorum.

This species, which is probably distributed all over the world, is extremely variable in almost every character ; it is also, perhaps consequently, able to survive in many kinds of environment, being found in brackish and even salt water, in rivers, canals, lakes and small ponds. I have recently found small but typical specimens in a pond in the Bombay Presidency, while in Bengal two forms occur that may be no more than local races, namely *S. proliferens* and *S. reticulata*. Apart from these, the closely related *S. alba* of Carter is a common Indian species and has recently been recorded from Africa *. In Europe and North America *S. lacustris* appears to be commoner than any other freshwater sponge ; in India it is much less abundant than the very distinct species *S. carteri* ; it has not as yet been recorded from Africa but is known from South America, while several closely allied forms, which may not be specifically distinct, occur in Australia : as a fossil it has considerable antiquity. From Great Britain the following recent species have been recorded as well as *S. lacustris* :— *Ephydatia fluviatilis*, *E. mülleri*, and *Spongilla fragilis* ; while *Tubella pennsylvanica*, *Heteromeyenia ryderi*, and a form probably conspecific with the North American *Ephydatia crateriformis*, have been found in Ireland. *Trochospongilla horrida* or *erinaceus* is the only other species known from Western Europe, but has not as yet been recorded from the British Isles. *S. lacustris* may be distinguished from all other species, in my opinion, by the following characters :—The sponge is soft and easily compressed, bright green when growing exposed to light ; as a rule a basal portion can be distinguished, bearing long cylindrical branches. The skeleton spicules are sharply pointed and smooth ; they are arranged so as to form distinct radiating fibres, which are joined together by less distinct transverse fibres or by single spicules in a network ; neither kind of fibre is very coherent. Numerous minute, pointed, cylindrical flesh-spicules, which are more or less uniformly covered with little spines, are scattered about in the substance of the sponge and in the external membrane. The gemmules, which generally have a yellowish colour, are spherical and open by a single aperture (in var. *multiforis* by several apertures) which is usually surrounded by a

* As *S. cerebellata*, Bowerbank ; see Kirkpatrick, Ann. & Mag. Nat. Hist. (ser. 7) xx. 1907, p. 524. Although *S. cerebellata* is certainly a form of *S. alba*, Carter, I cannot agree that the latter is not distinct from *S. lacustris*, close ally as it is of this species.

cup-shaped chitinoid funnel. The spicules on the gemmule are arranged in two layers, one of which lies parallel to the external surface of the gemmule outside, while the other is tangential to the internal coat and is more or less irregularly arranged; in form the gemmule-spicules resemble the flesh-spicules but are always stouter.

Of Scottish examples of this sponge I possess three sets,—one from the Glasgow Canal at Edinburgh, given me by Mr. W. Evans and taken in October 1907, one (a single specimen) given me by Sir John Murray and labelled "River Dee at Crossmichael, water 4 to 6 feet deep, 27th June, 1905," and one obtained by myself from Loch Baa in Mull, in October 1907. Each of these sets of specimens represents a different form or phase of the species; but it is, in my opinion, better not to separate them as varieties. The term "var.," at any rate in the Spongillinæ, has several different meanings, such as local race, temporary or seasonal phase, modification directly due to environment, distinct and permanent form distinguished by small but constant differences, and so on: in most cases it is impossible to say exactly what it means, and its use is merely the confession of a desire "to beg the question." It seems to me that if two forms are found growing together on a number of occasions in a number of localities, and if the specimens taken on different occasions are consistently different *inter se*, they should be regarded as distinct species, no matter how small the difference may be. If, however, different forms are only found in different localities or environments, or at different times of year, but agree in the majority of their characters, then they are probably no more than temporary phases which would not breed true if their environments were changed. It must be confessed, however, that such rules are easier to make than to keep. Especially in the Eastern tropics, the Spongillinæ have only been studied in a very few localities; I have rarely visited a new locality in India without finding forms that were previously unknown to me and did not agree with any published description. It has not always been possible to decide in a very definite manner whether these were true species or not, and I have usually adopted the system of giving even doubtful species names, trusting to future researches to confirm or disprove their valency. It is almost impossible to make progress in classifying or arranging a large collection unless the specimens are given names. Personally I regard many of the species I name without seeing "types," whether they be "new" or old, as named provisionally. Many published descriptions of the lower invertebrates are quite inadequate, and organisms so plastic as the sponges, as a matter of fact, conform imperfectly to any system of nomenclature as yet defined; unfortunately it is almost impossible, at any rate in a warm climate, to keep them alive and healthy in captivity, and so study their variation from generation to

generation. It is by no means improbable that someone will some day evolve a system of classification such as that foreshadowed in Bernard's "Catalogue of the Madreporarian Corals in the collection of the British Museum" as regards *Porites*, in which species are no longer recognized. At present, at any rate by museum zoologists, generic and specific names cannot be ignored, for no satisfactory substitute for them has yet been proposed.

The specimens of *S. lacustris* from Edinburgh may be taken to represent the typical form of the species, but even they are not absolutely identical *inter se* ; some of them have no branches, while in others these structures are well developed, as is usually the case in British specimens. In the branchless examples the skeleton spicules are rather shorter than in the others. In the branched examples the gemmules are abundant, being young and imperfectly developed towards the distal end of the branches, but fully formed at their bases and in the flat part of the sponge. There are no gemmules in the specimens without branches, which are probably immature.

The specimen from the River Dee encrusts the stem of a water-weed and is devoid of branches. It contains a few gemmules of unusually large size, but apparently still immature, the internal coat being very soft and as yet having few spicules and no crust associated with it. The skeleton in this form is rather more coherent than usual, but cannot be compared in this respect with that of *S. alba*, which is hard to the touch.

I have refrained from giving measurement of the spicules or gemmules so far, because I believe that measurements of these structures in the more variable species of *Spongilla* are apt to lead to confusion by being taken as standards of comparison ; there is nothing really remarkable as regards them either in the specimens from Edinburgh or in that from the River Dee.

The third Scottish form I have examined is altogether more abnormal. I found it in considerable abundance on the lower surface of stones near the edge of Loch Baa in the island of Mull. Several of my specimens had evidently attained their full growth, being practically dead and consisting merely of skeletons to which a few cells still adhered. Notwithstanding their abundance, however, no specimen measured as much as 10 mm. in diameter ; there was no trace of branches, each sponge consisting of a little mound-shaped structure of oval outline and having a single osculum of relatively large size. The gemmules, although they were fully formed, bore no spicules, and the flesh-spicules were very few, occurring only in the substance of the sponge. The colour, considering the conditions under which the sponges were growing, was normal, being a dirty cream where they were shut off from light and a faint green where

a little light reached them between the stones. The spicules and gemmules, as perhaps was natural, were smaller than usual; the gemmules measuring about 0·334 mm. in diameter, and the skeleton-spicules being 0·279 mm. long and proportionately rather slender. Distinct spicule-fibres projected vertically from the surface.

On the whole, this form of *S. lacustris* from Mull is nearly as worthy of specific rank as my *S. reticulata* from Eastern Bengal, although its peculiarities lie in a different direction, the Indian form * being distinguished by the great development of its branches, which are laterally compressed and anastomose to form a reticulated structure. The Mull sponge, however, is linked to the typical *S. lacustris* by one found in America and named by Bowerbank † *S. lacustris* var. *abortiva*, which has few spicules on the gemmule and an apparently aspiculous dermal membrane. This form, however, is described by Potts ‡ as "coating and branching," and has the skeleton-spicules rather stout; there is no crust on the gemmules, a character in which it agrees with the Hebridean form. I do not propose, for reasons stated above, to give the latter a name, but it is a form of considerable interest, possibly a distinct local race. *S. proliferens* from Bengal resembles it in its small size and has no true branches, but is remarkable for its prolific reproduction by means of external buds and has a tubular outgrowth attached to the foramen of the gemmule.

There is one other point to which it may be interesting to refer before leaving *Spongilla lacustris* (on which there is already far more literature than on any other species), namely, its occasional association with a Phylactolæmatous Polyzoon. Growing in the substance of the specimens given me by Mr. Evans I found a *Plumatella* identical with Allman's *P. coralloides*, which was originally found in similar circumstances. This Polyzoon is a temporary phase of the same author's *P. fruticosa*, not of Linné's *P. repens* as I formerly § thought. The same phase is common in *S. carteri* in Calcutta and Bombay, and occurs occasionally in the former locality in at least one other species of sponge, viz., *S. crassissima*, the hardness of which, however, is evidently less favourable to its growth.

TUBELLA PENNSYLVANICA, *Potts*.

Tubella pennsylvanica, Potts, Proc. Acad. Nat. Sci. Philadelphia, 1887, p. 14; Hanitsch, Irish Naturalist, iv. p. 129, 1895.

This species was originally described from several localities in the United States, and was later recorded by Hanitsch from the West of

* 'Records of the Indian Museum,' i. p. 387. † Proc. Zool. Soc. 1863, p. 470.

‡ Potts, Proc. Acad. Nat. Sci. Philadelphia, 1887, p. 189.

§ Journ. Asiat. Soc. Bengal, 1907, p. 88. Allman says that the statoblasts are broad, but figures them as somewhat elongated (Monograph of the Freshwater Polyzoa, p. 103, pl. vii. fig. 4).

Ireland. Hanitsch's specimens, like my own, were devoid of gemmules; but I think there can be little doubt that his identification is correct. My specimens were found on the lower surface of stones at the edge of Loch Baa, together with the peculiar form of *Spongilla lacustris* described above, and with specimens of the Polyzoon *Fredericella sultana*, some of which were enclosed in the substance of the sponge as far as the base of the colony was concerned, but were not perceptibly modified thereby.

The sponges were in the form of rather thin crusts with a circular or oval outline and not more than about 3 cm. in diameter. The surface was raised at one or more points into conical eminences resembling volcanoes in miniature, on the summit of which the oscula opened; numerous furrows beneath the dermal membrane radiated from each osculum. The mass was moderately soft, although the spicules were abundant, the skeleton being incoherent; the spicules were sharply and rather abruptly pointed, measuring on the average 0·201 by 0·0125 mm.; the shafts were densely covered with short, sharp, straight spines, but the points were smooth; no blunt spicules or developing rotules were seen. Numerous embryos were present in the substance of the sponge.

The identification of a specimen devoid of gemmules is always a little uncertain in the Spongillinæ; but the spicules of *Tubella pennsylvanica*, although several forms of the species have been described as varieties, have a very characteristic appearance, and the external and skeleton characters of my specimens accord well with Potts's description.

Tubella pennsylvanica was one of the three North American forms recorded by Hanitsch (*op. cit.*) from the West of Ireland in 1895, and regarded by him, and later by Scharff *, as evidence of a faunistic connection between that district and America. Of one of these species, however, I have found, both in Calcutta and in the Western Ghats (Bombay Presidency), a very close ally, which may ultimately have to be considered as no more than a local race, namely *Ephydatia indica* †, which is possibly a form of the North American *E. crateriformis*, with which Hanitsch, I think rightly, associated an immature sponge in his Irish collection ‡. Moreover, *Trochospongilla latouchiana*, only known from Calcutta, bears much the same relation to *T. leidyi*, another North American species which has not as yet been recorded from Europe. The retiring habits and small size of *Tubella pennsylvanica* render it liable to be overlooked, and I have

* 'European Animals,' p. 34, 1907.

† Annandale, Journ. Asiat. Soc. Bengal, 1907, p. 21, and 'Records of the Indian Museum,' i. p. 272, 1907.

‡ The distribution of the third form in Hanitsch's Irish collection (*Heteromeyenia ryderi*) is apparently discussed by Miss J. Stephens ('Irish Naturalist,' 1905) in a paper I have not seen.

little doubt that it exists in other British lakes as well as in Loch Baa. In any case, the freshwater sponges, being very easily carried abroad in the form of gemmules, are, like the Phylactolæmatous Polyzoa with their statoblasts, too widely distributed as a rule, although some species are strangely local, to afford a sound basis for argument as to the geological history of any country. In some cases, moreover, environment appears to be a more important feature in their distribution than locality; and we find instances like that of *Ephydatia plumosa*, which is common in Bombay and of which local races have been found in Mexico and in Lake Tanganyika, while closely allied forms occur in the Malay Peninsula and Australia, but a close two years' search has failed to discover any ally in Calcutta.

Although it is in a high degree probable that species other than the two discussed above occur in Scotland, I have been unable to find records that refer certainly to any other than *Spongilla lacustris*. It is possible, however, that such records exist, for our Indian libraries are naturally incomplete as regards the publications of local societies in Scotland and works confined to the local faunas of Great Britain generally. Weltner * in his list of the known species (1895) does not distinguish Scotland from England and Ireland, and I have not seen any reference to later records from Scotland in any of the usual sources of information on such points. I hope, however, that these notes will be of use, if only they assist in calling attention to the fact that the freshwater fauna of the British Isles is very imperfectly known, a fact strikingly illustrated by Mr. Tate Regan's † recent paper on the species of *Coregonus* that occur in the English lakes. The investigations into the fauna of the Scottish lakes undertaken by Sir John Murray and his colleagues are mainly concerned with the plankton; the bottom fauna has remained almost an untrodden field since Allman carried out the classical researches embodied in his Monograph of the Freshwater Polyzoa (1856).

* Wiegmann's Archiv f. Naturgesch. lxvi. p. 114.

† Ann. & Mag. Nat. Hist. (7) xvii. p. 180, 1906.